

CLAIMS:

1. A current sensor, comprising:

one middle leg magnetic circuit(1) having opposite ends;

5 two outer leg magnetic circuits(2a,2b) connected with one
and the other ends of the middle leg magnetic circuit(1),
respectively;

an exciting means(3a) arranged in the outer leg magnetic
circuit(2a) and an exciting means(3b) arranged in the outer leg
10 magnetic circuit(2b);

a flux detecting means(4) arranged in the middle leg
magnetic circuit(1);

drive means(7) for driving the exciting means(3a) and the
exciting means(3b), respectively; and

15 a detection circuit(8) connected with the flux detecting
means(4) and outputting the electric signals interlocked with
the flux being detected by the flux detecting means(4).

2. A current sensor according to claim 1, further
20 comprising:

a balance recovery coil(5) arranged by winding a wire
around at least one of the middle leg magnetic circuit(1) and
the outer leg magnetic circuits(2a,2b);

a balance recovery current controlling circuit(9) for
25 controlling the balance recovery current run along the balance

recovery coil(5) to decrease the flux being detected by the flux detecting means(4), based on the electric signals being output from the detection circuit(8); and

a detected value outputting circuit(10) for outputting the
5 balance recovery current value.

3. A current detecting method, comprising:

achieving magnetic balance condition by generating the first excited flux which is an alternating flux to run along a
10 middle leg magnetic circuit(1) by an exciting means(3a) and generating the second excited flux, of which the magnitude is as same as that of the first excited flux and the direction is reverse to that of the first excited flux, which is an alternating flux to run along the middle leg magnetic
15 circuit(1) by an exciting means(3b);

achieving magnetic non-balance condition due to collapse of the magnetic balance condition, which is caused by running detected current along a detected wire(6) passed through at least one of the window which is formed by being surrounded by
20 an outer leg magnetic circuit(2a) and the middle leg magnetic circuit(1) and the window which is formed by being surrounded by an outer leg magnetic circuit(2b) and the middle leg magnetic circuit(1) to vary the magnetic reluctance of the outer leg magnetic circuit(2a) and the outer leg magnetic
25 circuit(2b); and

detecting the detected current running along the detected wire(6) by detecting the flux which is generated along the middle leg magnetic circuit(1) through achieving the magnetic non-balance condition, by a detection circuit(8) outputting the electric signals interlocked with the flux being detected by a flux detecting means(4).

4. A current detecting method, comprising:

achieving magnetic balance condition by generating the first excited flux which is an alternating flux to run along a middle leg magnetic circuit(1) by an exciting means(3a) and generating the second excited flux, of which the magnitude is as same as that of the first excited flux and the direction is reverse to that of the first excited flux, which is an alternating flux to run along the middle leg magnetic circuit(1) by an exciting means(3b);

achieving magnetic non-balance condition due to collapse of the magnetic balance condition, which is caused by running detected current along a detected wire(6) passed through at least one of the window which is formed by being surrounded by an outer leg magnetic circuit(2a) and the middle leg magnetic circuit(1) and the window which is formed by being surrounded by an outer leg magnetic circuit(2b) and the middle leg magnetic circuit(1) to vary the magnetic reluctance of the outer leg magnetic circuit(2a) and the outer leg magnetic

circuit(2b);

achieving magnetic re-balance condition by running balance recovery current along a balance recovery coil(5) to decrease the flux being generated along the middle leg magnetic circuit(1) in the condition that magnetic reluctance of the outer leg magnetic circuit(2a) and the outer leg magnetic circuit(2b) is varied, wherein the balance recovery current, which generates the flux of which the magnitude is as same as that of the flux being generated along the magnetic circuit around which the detected wire(6) is wound by being passed therethrough in the condition that the magnetic reluctance of the outer leg magnetic circuit(2a) and the outer leg magnetic circuit(2b) is varied and the direction is reverse to that of the said flux, is run along the balance recovery coil(5) which is wound by being passed through the same window as the window through which the detected wire(6) is passed; and

detecting the detected current running along the detected wire(6) by detecting the balance recovery current running along the balance recovery coil(5) in the magnetic re-balance condition.

5. A current sensor, comprising:

one magnetic circuit(1) having opposite ends;

magnetic circuits(21a,21b) having opposite ends, wherein the respective one ends of the magnetic circuits(21a,21b) are

connected with one end of the magnetic circuit(1);

magnetic circuits(22b,22a) having opposite ends, wherein the respective one ends of the magnetic circuits(22b,22a) are connected with the other end of the magnetic circuit(1), and
5 the other ends of the magnetic circuits(22b,22a) are connected with the magnetic circuits(21a,21b), respectively;

one magnetic circuit(2) having opposite ends, wherein one and the other ends of the magnetic circuit(2) are connected with a contact between the magnetic circuits(21a,22b) and a
10 contact between the magnetic circuits(21b,22a), respectively;

an exciting means(3) arranged to generate the flux along the magnetic circuit(2);

a flux detecting means(4) arranged to detect the flux of the magnetic circuit(1);

15 a drive means(7) for driving the exciting means(3); and

a detection circuit(8) connected with the flux detecting means(4) and outputting the electric signals interlocked with the flux being detected by the flux detecting means(4).

20 6. A current sensor according to claim 5, wherein, in the case that the exciting means(3) is a coil, the coil is arranged to be passed at least one time through both of the window surrounded by the magnetic circuits(21a,21b) and the magnetic circuit(2) and the window surrounded by the magnetic
25 circuits(22a,22b) and the magnetic circuit(2).

7. A current sensor according to claims 5 or 6, wherein,
in the case that the flux detecting means(4) is a coil, the
coil is arranged to be passed at least one time through both of
5 the window surrounded by the magnetic circuits(21a,22b) and the
magnetic circuit(1) and the window surrounded by the magnetic
circuits(22a,21b) and the magnetic circuit(1).

8. A current sensor according to any one of claims 5 to 7,
10 wherein the magnetic circuit(1), the magnetic
circuits(21a,22a), the magnetic circuit(21b,22b), the magnetic
circuit(2) and the exciting means(3) form a magnetic bridge.

9. A current sensor according to any one of claims 5 to 8,
15 further comprising:

a balance recovery coil(5) arranged in any position in the
magnetic bridge formed by the magnetic circuit(1), the magnetic
circuits(21a,22a), the magnetic circuit(21b,22b), the magnetic
circuit(2) and the exciting means(3);

20 a balance recovery current controlling circuit(9) for
controlling the balance recovery current run along the balance
recovery coil(5) to decrease the flux being detected by the
flux detecting means(4), based on the electric signals being
output from the detection circuit(8); and

25 a detected value outputting circuit(10) for outputting the

balance recovery current value.

10. A current detecting method, comprising:

achieving magnetic balance condition in which the flux by
5 an exciting means(3) is not present in a magnetic circuit(1),
by properly selecting the magnetic reluctance of magnetic
circuits(21a,21b,22a,22b) to equalize magnetic potential of the
opposite ends of the magnetic circuit(1);

achieving magnetic non-balance condition due to collapse
10 of the magnetic balance condition, which is caused by running
detected current along a detected wire(6) passed through at
least one of the window surrounded by the magnetic
circuits(21a,22b,1) and the window surrounded by the magnetic
circuits(21b,22a,1) to vary the magnetic reluctance of at least
15 one of the magnetic circuits(21a,22a,21b,22b); and

detecting the detected current running along the detected
wire(6) by detecting the flux which is generated along the
magnetic circuit(1) through achieving the magnetic non-balance
condition, by a detection circuit(8) outputting the electric
20 signals interlocked with the flux being detected by a flux
detecting means(4).

11. A current detecting method, comprising:

achieving magnetic re-balance condition by running balance
25 recovery current along a balance recovery coil(5) to return to

the magnetic reluctance prior to variation the varied magnetic reluctance of the magnetic circuit of which the magnetic reluctance is varied and thus decrease the flux being generated along a magnetic circuit(1) in the condition that the magnetic
5 reluctance of at least one of magnetic circuits(21a,22a,21b,22b) is varied, wherein the balance recovery current, which generates the flux of which the magnitude is as same as that of the flux being generated along the magnetic circuit around which a detected wire(6) is wound
10 by being passed therethrough in the condition that the magnetic reluctance of at least one of the magnetic circuit(21a,22a,21b,22b) is varied and the direction is reverse to that of the said flux, is run along the balance recovery coil(5) which is wound by being passed through the same window
15 as the window through which the detected wire(6) is passed; and
detecting the detected current running along the detected wire(6) by detecting the balance recovery current running along the balance recovery coil(5) in the magnetic re-balance condition.

20

12. A magnetic bridge, comprising:
one middle leg magnetic circuit(1) having opposite ends;
two outer leg magnetic circuits(2a,2b) connected with one
and the other ends of the middle leg magnetic circuit(1),
25 respectively;

an exciting means(3a) arranged in the outer leg magnetic circuit(2a) and an exciting means(3b) arranged in the outer leg magnetic circuit(2b);

a flux detecting means(4) arranged in the middle leg
5 magnetic circuit(1); and

drive means(7) for driving the exciting means(3a) and the exciting means(3b), respectively;

wherein the magnetic bridge achieves magnetic balance condition by generating the first excited flux which is an
10 alternating flux to run along the middle leg magnetic circuit(1) by the exciting means(3a) and generating the second excited flux, of which the magnitude is as same as that of the first excited flux and the direction is reverse to that of the first excited flux, which is an alternating flux to run along
15 the middle leg magnetic circuit(1) by the exciting means(3b).

13. A magnetic bridge, comprising:

one magnetic circuit(1) having opposite ends;

magnetic circuits(21a,21b) having opposite ends, wherein
20 the respective one ends of the magnetic circuits(21a,21b) are connected with one end of the magnetic circuit(1);

magnetic circuits(22b,22a) having opposite ends, wherein the respective one ends of the magnetic circuits(22b,22a) are connected with the other end of the magnetic circuit(1), and
25 the other ends of the magnetic circuits(22b,22a) are connected

with the magnetic circuits(21a,21b), respectively;

one magnetic circuit(2) having opposite ends, wherein one
and the other ends of the magnetic circuit(2) are connected
with a contact between the magnetic circuits(21a,22b) and a
5 contact between the magnetic circuits(21b,22a), respectively;

an exciting means(3) arranged to generate the flux along
the magnetic circuit(2);

a flux detecting means(4) arranged to detect the flux of
the magnetic circuit(1); and

10 a drive means(7) for driving the exciting means(3);

wherein the magnetic bridge achieves magnetic balance
condition in which the flux by the exciting means(3) is not
present in the magnetic circuit(1), by properly selecting the
magnetic reluctance of the magnetic circuits(21a,21b,22a,22b)
15 to equalize magnetic potential of the opposite ends of the
magnetic circuit(1).

14. A magnetic bridge, comprising:

magnetic circuits(21a,21b) having opposite ends, wherein
20 one ends of the magnetic circuits(21a,21b) are connected;

magnetic circuits(22b,22a) having opposite ends, wherein
one ends of the magnetic circuits(22b,22a) are connected, and
the other ends of the magnetic circuits(22b,22a) are connected
with the magnetic circuits(21a,21b), respectively;

25 one magnetic circuit(2) having opposite ends, wherein one

and the other ends of the magnetic circuit(2) are connected with a contact between the magnetic circuits(21a,22b) and a contact between the magnetic circuits(21b,22a), respectively;

an exciting means(3) arranged to generate the flux along
5 the magnetic circuit(2); and

a drive means(7) for driving the exciting means(3);

wherein the magnetic bridge achieves magnetic balance condition in which magnetic potential of the contact between the magnetic circuits(21a,21b) and the contact between the
10 magnetic circuits(22b,22a) is equalized by properly selecting the magnetic reluctance of the magnetic circuits(21a,21b,22a,22b) .